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Effects of Processing on Nutrient Compounds and Sensory Properties of Parascolopsis aspinosa and Parastromateus niger in Behbahan, Southern Iran

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Highlights: The paper addresses the "fish processing" and is important because "Proximate composition and of raw and processed samples and sensory attribute of *Parascolopsis aspinosa* and *Parastromateus niger*".

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ABSTRACT - The effects of different processes on proximate composition and sensory indexes two fish species investigated. Used methods were AOAC for analysis of samples. Frying method decreased protein amount in *Parascolopsis aspinosa* (Rao & Rao, 1981), but roasting reduced the protein contents *Parastromateus niger* (Bloch, 1795). The highest fat amount in *Parascolopsis aspinosa* but the lowest fat amount found for *Parastromateus niger*. *Parascolopsis aspinosa* protein amount decreased by frying way. It can be concluded that some heat processing ways were affected on samples proximate compounds. The effects of frying and boiling on samples sensory properties found significantly different from that of roasting way.

Keywords: Processing ways; Fish samples; Proximate compounds; Sensory properties.

INTRODUCTION

These two species of fish were studied due to the abundance of catch and delicious taste. The effects of boiling, baking, and frying, on the proximate of fish have been described in the literature (Ersoy & Ozeren 2009; Hosseini et al., 2014; Jensen et al., 2014; Karimian-Khosroshahi et al., 2015). The cooking methods to the loss of WHC, water-holding capacity, led to the concentration and increase amounts of proteins, fat, and ash in cooked fish (Momenzadeh et al., 2017) and meat (Jensen et al., 2014). However, specific changes, duo to the cooking process, are very diverse; thus, a brief discussion, related to the impact of cooking methods on the content of proteins, lipids, vitamins, and minerals in fish has been showed (Madalena et al., 2018). The use of roasting way has been increased more than tens of years (Garcia-Arias, et al., 2003b). The heat processing ways were affected the macronutrients amounts of seafood such as, protein, fat, ash, especially vitamins, elements, polyunsaturated fatty acids and flavor compounds. The effects heat processing ways on macro-nutrients and elements of some seafood were reported (Ersoy, et al., 2006; Kucukgulmez, et al., 2006; Weber, et al., 2008*;* Stephen, et al., 2010). The seafood is baked before eating by people in Iran. The thermal usual ways were found to maintain and to use for consumers (Oluwaniyi omolara & Dosumu omotaya, 2009). It is therefore important to maintain nutrients in cooked fish using several conventional heat process ways. To date, there is no information on the nutritional values of raw and cooked fish.

Roasting does not have a significant effect on most vitamins and minerals, except for B vitamins. Frying makes food taste delicious, and it can provide some benefits when healthy oils are used. It's best to avoid frying fatty fish and minimize the frying time of other foods.

Overall, fish is known in the people diet as a good and valuable source of animal protein. Fish is used by people in many countries, not only because of its high quality biological protein but also for its high unsaturated fats. This includes n-3 unsaturated fatty acids, which reduce the risk of heart disease in adults and are very important for growth in infants and young adults and well support health (Uauy et al. 2003). Although fish are a good source of some nutrients, cooking ways can produce changes in fatty acids and amino acid profile same changes in solubility and nutritional values (Erickson, 1987). Because raw fish are not eaten, different processing methods are used for consumption, and some of these methods include boiling, frying and grilling, which can have various effects on nutritional and sensory properties. (Erickson, 1987).

The studies previously have reported the effects of heat treatments on different fish species. Greenfield & Kosulwat, (1991 reported cooking different procedures on different foods can be affected on fat and other nutrients. The amount of fresh seafood fat was affected in the interactions between fats and fish fats during cooking. Nutrient content data for fish are available for raw fish and data on processed fish seems to be inadequate. Therefore, the processing effect is high on the fish nutrient (Sanchez Moniz, 1992). The aim of this study was effects of different processing methods on the macronutrients and sensory attributes of two fish species.

MATERIAL AND METHODS

a). Materials and sample preparation

The 30 fish samples were obtained from two different species, with length of 21-36 cm and weight 250-460 g from the fish market in Behbahan, Khuzestan province of Iran. They were kept in a clean plastic container in the crushed ice and transferred to the laboratory in Behbahan Katam Alanbia University of Technology, Behbahan, Iran. After entering the laboratory, samples of fish were washed several times with distilled fresh water, and then were immersed in ice for six minutes before remove wastes and deheading. Fish then was filleted and was divided into four sections. The two fish species were called *Parascolopsis aspinosa,* (Govasim cheshm dorosht), and *Parastromateus niger* (Halva sia). The species of fish are selected because inexpensive and accessible for Iranian average people. The two fish species divided to 4 sections; one section was used for boiling. The section was used for frying in plant oil by a baking dish, but the another section was used for roasting on hot dish. The last section was used for raw sample analyzing. Boiling of samples was carried out for about 25 min in distilled water until the components were well baked. The frying was carried out by corn oil in an open flame with periodic rotation. The frying carried out

for 20 min and at 245 ºC. Cooked at 160 °C and it was finished in 20 min. All processing ways were done without adding any material. All samples were homogeneous before analysis.

b) Analytical Procedures

The AOAC standard methods were carried out for analysis for the samples (AOAC, 2005). The ash was determined by burning 1.0 gr of samples in the furnaces stored at 500 ° C for 5.5 hr (Kjeldahl, 1983). The amount of moisture was measured by placing 2.0 g of each sample in a furnace with a temperature of 105 ° C until fixed weight was determined. The oil was determined by extraction of 0.5 g each sample in a soxhlet device using petroleum oil (40-60 °C) as extractor (AOCS, 1979). Crude protein (% total nitrogen x 6.25) was measured using Kjeldahl method.

c). Organoleptic properties assessment method

Descriptive analysis was used in the analysis of organoleptic properties. Staff and students were used to carry out this test. 20 members were selected as a panel group to evaluate any flavor, texture, appearance, and palatability. Fish samples and questionnaires were prepared were given to board members and were asked to evaluate the samples for taste, texture, flavor and palatability (Aremu & Ekunode, 2008). This study was approved by the Ethics Committee for Human Research. The samples were not added to any spices and were subjected to sensory analysis.

d). Statistical analysis

The obtained data were showed as the average of triple experiences. Results were analyzed using one-way ANOVA. Mean values were significant with $p < 0.05$. The data represent mean ± standard deviation.

RESULTS AND DISCUSSION

Obtained results has been showed in Tables 1, 2, 3 and 4.

Table 1. Proximate composition and of raw and processed samples of Parascolopsis aspinosa (% in dried matter).

Nutrients	Raw	Boiled	Roasted	Fried
Moisture (%)	51.33 ± 1.39a	44.4 ± 0.55b	43.77 ± 0.55b	26.53 ± 1.48c
Protein (%)	32.42 ± 2.89b	34.55 ± 0.96a	44.33 ± 1.82c	32.54 ± 1.26d
Lipid (%)	11.83 ± 0.45a	9.36 ± 1.46b	4.55 ± 0.39ab	34.14 ± 1.85c
Ash (%)	3.33 ± 0.12a	5.13 ± 0.13c	6.15 ± 0.12b	2.00 ± 0.13c
Carbohydrates	1.17	6.56	1.20	4.79
Calorie (Kcal)	247.31	255.59	255.59	625.79

Values are shown as mean ±standard deviation of triplicates. Values within the same row have different superscripts are significantly different ($p < 0.05$).

Table 2. Proximate composition and calorie values of raw and processed Parastromateus niger (% in wet matter)

Nutrients	Raw	Boiled	Roasted	Fried
Moisture (%)	70.85±0.61a	74.33±0.63b	64.46±0.57c	39.49±0.32d
Protein (%)	5.81±0.67a	4.47±0.08b	2.56±0.06c	18.71±0.12d
Lipid (%)	17.70±0.31a	17.48±0.32a	26.56±0.37b	36.78±0.41c
Ash (%)	3.51±0.10a	4.56±0.13b	3.40±0.12c	3.51±0.08c
Carbohydrates	2.12±0.13a	0.76±0.06b	2.41±0.13a	2.44±0.10a
Calorie (Kcal)	132.42±0.31a	105.29±0.18b	141.61±0.14c	334.75±1.01d

Values are shown as mean ±standard deviation of triplicates. Values within the same row have different superscripts are significantly different ($p < 0.05$).

Table 3. *Sensory attributes* of *Parascolopsis aspinosa*

Processing method	Flavor	Outside	Tissue	Delicious
Roasted	1.7±0.91[a]	1.88±1.10[a]	3.6±0.30[c]	1.6±0.66[a]
Fried	1.9±0.93[a]	2.8±0.70[ab]	2.6±0.71[a]	2.66±0.93[b]
Boiled	2.6± 1.10[b]	2.5± 1.20[b]	3.88 ± 0.01[c]	1.88 ± 0.85[c]

Values with the same superscript letter within the same column are not statistically different ($p<0.05$).

Table 4. *Sensory attributes* of *Parastromateus niger*

Processing method	Flavor	Outside	Tissue	Delicious
Roasted	2.1 ± 0.87[a]	1.7± 1.09[a]	3.3 ± 0.31[c]	1.6 ± 0.83[a]
Fried	2.6± 0.78[ab]	1.7 ± 0.83[ab]	1.7 ± 0.62[a]	1.8 ± 0.93[b]
Boiled	3.8± 1.09[b]	2.6± 1.09[b]	3.8 ± 0.30[c]	2.7± 1.09[b]

Values with the same superscript letter within the same column are not statistically different ($p<0.05$).

Obtained results from Table 3 showed that flavor and tissue properties in boiled *Parascolopsis aspinosa* fillet found better than roasted and fried two samples, while outside and delicious properties of fried sample was the best. Results in Table 4 showed that all sensory properties in boiled *Parastromateus niger* fillet found the better than others. Therefore, boiling process in *Parastromateus niger* was best from point of *Sensory attributes*.

Frying caused the amount of moisture in the fish to be minimized. The reaction of water with oil in seafood, at high temperatures, during thermal processes same frying, found an effect on some of the nutrients and changes in the structure of the oil and the denaturing of protein (Stephen et al., 2010), which explains significant differences in moisture content during different processes. Roasting and frying methods at 160 °C and 245 °C respectively were carried out, and according to the expects of these processing ways, led to exit of water from fillet since this temperature was more than boiling.

Reducing water amount was a useful, because it reduces the sensitive of fish to bacterial spoilage, oxidation of unsaturated fat, and thus improves the quality and presentation of fish (Candella, et al., 1998). The moisture and ash contents of the boiled samples were not significantly different with the fresh sample. In fact, fresh and boiled samples were approximately same in moisture content. This may be due to the fact that the boiling temperature was not high to cause morphological changes in the samples. However, the roasting significantly reduced the oil content in *Parastromateus niger* (Table 1).

The oil amount in all fried fish samples increased. According to studies, frying does not always increase the amount of fat in marine fish (Candella et al., 1998). In addition, Candela et al. showed that different species of fish show different behavior during frying process when determination of fish total fat (Adeyeye & Adamu, 2005). Because fish are used as the main source of protein in human food, it is very important that during its preparation, the amount of protein is not damaged. *Parascolopsis aspinosa* found the highest crude protein, but *Parastromateus niger* found the lowest (Table 2). The because of degradation of amino acids at very high temperature, this way reduce the amount of amino acids and then reduce protein amount.

The crude protein amount of two fresh fish (*Parascolopsis aspinosa* and *Parastromateus niger*) was not significant ($p <0.05$), and boiling and frying methods did not significant effect on protein content. The highest amount of ash for *Parascolopsis aspinosa* was found with roasting method, next boiling and frying methods, respectively. This can be because volatility of minerals during preparation of roasted and fried samples.

It was showed with statistical analysis, that the processing ways significant ($p <0.05$) with the samples ash amounts, but it is not a significantly difference in the amounts of ash of raw samples ($p <0.05$). The amounts of ash two species of fresh fish found between the range in fish species (Aremu & Ekunode, 2008; Garcia Arias et al., 2003). After cooking, moisture amount in all treatments samples were decreased.

The obtained results agreed to fried and boiled *Silver barb,* walking catfish, fried Spanish fish and boiled striped catfish. This study results and literature review data show that frying the high amount of water loss and fat amount more than other processes ($p <0.05$), which fat absorbed during frying method (Morris et al., 2004). The nutritional value of seafood and the type and amount of damages was affected by processes. Heating may dry samples and reduce the water content that

leads to hydration changes, so that protein and fat contents in seafood increased. Changes in nutrients are due to effect temperature with nutrient that occurs in the process. In general, reducing the amount of water and increasing other nutrients occurs will be done. An important factor, baking effects on the fish fat content. The fat content in a fried sample was more due to oil absorption by fish, agreed with findings reported previously (Echarte & Zulet, 2001; Beklevik et al., 2005).

In this study, the high protein amount and the low amount of fat were found in obtained samples by roasting method. Therefore, this method can be proposed as a suitable method for processing *Parascolopsis aspinosa* fish as a healthy diet. The amount of high protein was found in baked *Parascolopsis aspinosa* was because of the concentration of fillet so that it is because decrease of moisture. The amount of protein in seafood is valuable because the biological values are very good due to its amino acid profile (Seidler, 1987).

Seidler (1987) investigated the effects of heat on protein digestion in the hake, a fish species. Fish muscle, heated for 130 min for 2 hours, which result to decreased digested protein. The processed samples by frying found a high fat and ash amounts more than raw samples. The research showed the same effects of this process on amounts of sample macro-nutrient. The amount of fat in fried samples was increased, which due to oil absorption and saturation of water during deep frying (Saguy & Dana, 2003). Saguy & Dana reported (2003), oil inters the fillet by frying method. The fat amount of sample by this action really will be increased. The data of present research were agreed to results of Rosa et al (2007). Gokoglu et al. (2004), reported that oil amount was significantly higher in fried sample than raw sample. The acceptable cause for increased fats and ash contents in samples by frying may be a decreased moisture content, which will then increase other composition, so that Unlusayin et al. (2001) showed same data.

a). Sensory attributes

Sensory attributes in boiled, fried and roasted *Parascolopsis aspinosa,* and *Parastromateus niger* fishes are shown in Tables 3 and 4. The flavor of the boiled *Parascolopsis aspinosa* significantly found difference to roasted *Parascolopsis aspinosa* ($p > 0.05$). It was not found any significantly differences ($p > 0.05$) in the flavor of the boiled and fried fish samples with roasted and boiled fish samples. The appearance check of boiled fish samples showed that it was found difference significant ($p > 0.05$) in comparison with the roasted fish samples, and it was not found any significant differences ($p > 0.05$) in the appearance of roasted and fried fish samples and the boiled and fried fish samples.

It was not found any significant differences ($p > 0.05$) in the texture of boiled and roasted fish samples. The texture of fried and roasted fish samples significant different ($P < 0.05$) in comparison with the fried and boiled fish samples. Anyway, it was not found any significant differences ($p > 0.05$) in the palatability of boiled and fried samples *Parastromateus niger,* but the palatability of the samples significant different ($P < 0.05$) in comparison with roasted fish samples and the fried and boiled fish samples, so presented in Tables 3 and 4.

The boiled fish samples found the maximum flavor and palatability indexes. The boiled samples found the maximum texture and appearance properties, followed by roasted fish samples. It is showed that among the thermal processes used to prepare fish, frying was best, if fish preserving be the target, but when focus is on nutrients preservation, boiling method the best item is. In present study, the maximum protein and the minimum amounts of fat were observed for roasted samples. Thus, roasting is proposed as the optimum thermal processing way.

The sensory attributes of samples carried out by a questionnaire. The results showed that the best texture properties were found in *Parascolopsis aspinosa* and *Parastromateus niger.* Fresh and fried *Paratromateus niger* found the highest protein amount and the highest amount of oil and then *Parascolopsis aspinosa*. This study clearly shows that proximate compounds can be useful in selecting seafood based on nutrients composition. Many factors were affected the nutritional content of seafood and the amount of processing losses. Heating can reduce seafood water content, leading to changes in hydration such as increased protein and fat concentration in seafood.

The nutrient changes were the result of the temperature at which the process took place. In general, there is a decrease in water content which is corresponding increase in other nutrients. So that this is an important factor to consider when cooking is its effect on the amount of fat in the fish.

The high amount of fat in the fried sample, is because of the more oil is absorbed by the muscle muscles, so similar findings have been previously reported (Aberoumand, 2014). Results of the another study carried out by Ali Aberoumand (2014) have shown that changes in the protein content were found to be significant more in fried and boiled samples.

The changes in the fat content were found to be significant more in fried and boiled samples. Another research work was carried out by Ali aberoumand et al., (2015) showed that Boiling process significant reduced ash content in the sample but fat content was significant was increased in fried sample. Baking process recorded highest ash content of 10.64%. The highest protein content was obtained for boiled sample (82.73%). Lipid content was recorded highest in fried sample (17.27%). *P. indicus* was, rich in fat, protein, and ash, thus its consumption should be encouraged (Aberoumand et al., 2015).

CONCLUSION

It can be concluded that some heat processing methods were affected on samples proximate compounds. The effects of boiling on samples sensory properties found significantly different from that of roasting and frying methods while boiling process found for *Parastromateus niger* was best from point of *Sensory attributes* and preparation for the healthy consumption of the analyzed fish.

Declaration of Conflicting Interests

The authors have declared that there is no conflict of interest.

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CRediT AUTHOR STATEMENT

Ali Aberoumand and Abdulah Yousefi: Investigation, Writing - Original Draft and Writing - Review & Editing.

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